

Cy Sician-Revolutionizing Patient Health Monitoring System with auto-diagnosis

Budhaditya Bhattacharya, Prakhar Jain, Sudeshna Das



Abstract: Cardiovascular diseases (CVD) has emerged as one of the major causes for death in all over the world. This paper displays a framework to remotely screen, health of Cardiovascular disease affected patients utilizing Machine to Machine (M2M) innovation which is a part of the project called CySician . Real time patient health monitoring system is advantageous to the patients and society as it will significantly reduce medical charges, waiting time for patient and improve patient handling capability of any hospital. In this patient health monitoring system pulse rate, ECG, body temperature, Body Mass Index(BMI) and general clinical interrogation is finished by a chatbot named “LifeBot”. The primary components associated with this project are pulse sensor, Raspberry Pi 3B+ (processing unit), temperature sensor module sensor, utilizing Machine Learning (ML) calculation it automatically analyzes the accumulated information to propose prescription to the patient. After the patient is diagnosed and the disease is detected, the patient will be notified with the kind of medication he needs. If the problem is nominal, the patient will be suggested with a basic treatment and will be monitored regularly. If the problem is of major scale, the patient will be directed to the payment gateway where he will be asked to pay a nominal fee for appointment from doctors to continue his check-up. Ultimately, the final well-being report is displayed to the doctor on the User interface that is visible on PC/Laptop.

Keywords: CVD, M2M, health monitoring; pulse rate, BP, ECG, BMI, LIFE BOT, ML, Raspberry Pi, payment gateway

I. INTRODUCTION

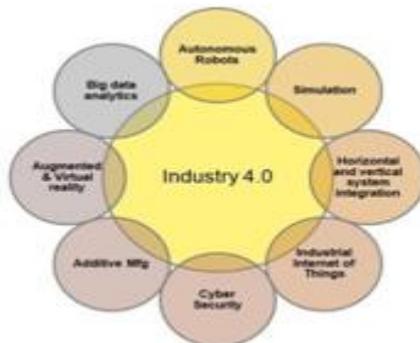


Fig. 1. Eight pillars of Industry 4.0[1]

With the advent of Industrial revolution a.k.a Industry 4.0 as shown in Fig.1 is a current trend of automation and data exchange in manufacturing technologies, which deploys the use of cyber physical systems or cyber physicians(from where the name “CySician” is extracted) , the Internet of things, cloud computing and cognitive computing and creating a smart world.

Cardiovascular diseases (CVDs) have now become one of the major causes of mortality in India. Of the more than 10 million deaths annually in India, almost two million are due to cardiovascular diseases. So, It is essential to seek alternative and innovative ways to provide affordable healthcare to the in- creasing population. To make reference to some Indian statistic measurements, in 2009, the mortality due to Cardiovascular diseases is 54% when contrasted with 1997 having mortality of 30%[2] .Heart rate variability, blood pressure, ECG, SpO2, temperature and respiration are an important tool for the diagnosis of cardiopathies[3][4]. Among the techniques used to determine the glucose level and the pulse rate, photo plethysmography gauges the changes in the blood stream by adopting an optical strategy[5]. PPG signals contain data like blood pressure, pulse rate and blood glucose saturation levels.[6]. It is a non-invasive wearable device to make measurements on the index finger. The signals generated provides information about both respiratory and cardiovascular systems [7]. Embedded devices catering the above are already in use in developed nations, however providing an economical, versatile and user friendly health check tool for the masses is the need of the hour, to target maximum users with minimum investment.

II. SYSTEM DESIGN

The functionalities targeted here in are limited to the use of following sensors:

- Blood Pressure Sensor – Sphygmomanometer
- Thermometer- Body Temperature sensor
- ECG sensor
- Pulse rate sensor

However, the functionalities can time and again be extended by including many more sensors, such as Spirometer, Glucometer, ECG, and much more [8]. This system architecture as shown in Fig.2 as stand- alone, multimodal user friendly equipment, which fetches the sensed data from each devices, then is captured by a microcontroller based device such as Raspberry Pi GPIO pins working on python programming, the same module is readily equipped with Wi-Fi module, this functionality enables the system to remotely share the collected data from the sensor to the cloud/server for computation with suitable algorithms, pre-programmed by means of data processing involving big data sciences forensuring statistical accuracy[9].

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E. Data Acquisition Unit

Raspberry Pi is an ARM based credit card sized Single Board PC made by Raspberry Pi Foundation. The association behind the Raspberry Pi comprises of two arms. The initial two models were created by the Raspberry Pi Foundation. After the release of Pi Model B, they developed the third model, the B+. Raspberry Pi is being used as the brain of Patient Monitoring system as shown in Fig.7. It is being utilized to interface the pulse rate, blood pressure sensor and ECG to real time monitoring database through web access. There are total 40 GPIO pins and the board is comprised of a shorter 26-pin header USB ports. USB port is significant for interfacing and as a medium to transfer programmed code to the hardware devices.



Fig. 7. Raspberry Pi 3B+

IV. METHODOLOGY

Our System uses the Python coding which is uploaded to the micro controller (Raspberry Pi 3B+). Further the coded program instructs the controller to fetch the information through the individual sensor’s serial out, all together simultaneously, in a single run, each time. The controller board is powered by a 5V input. The sensors are powered from the board’s 3.3V out or through a 5V channel, subjective to the requirements, and based on its type the sensor serial out is connected to digital or analog pin. The coded instructions is dedicated to the ports circuit predefined in its program. The data captured during the runs each time is collectively shared over the website, here the sharing protocol is governed by googles sheet web app deployment that takes real time data from the system, once the raw data from the device is made available in the google sheet. Correspondingly the data is taken into a more convenient format, and is processed accordingly by means of standard computational sheets (in this case Microsoft Excel). This data gets refreshed every 1 minute, by the means of connections established. The basic user details are also fetched from the device and this allows one processing template to be used for the data collected from different controllers.

The processed data is represented by the means of graphs, showcasing the standard limits and remarks specified by Microsoft Excel logical queries/formulae, subjective to medically suggested normal thresholds the real time hardware data is assembled by the devices as shown in Fig.8 and put away in “Google Firebase” server. The information accumulated are sent to the Website which goes about as a front- end in our framework. Website based user

interface named “Life Care”, shown in Fig.9 is designed to allow the patients to make an account and provide their personal details as in Fig.10. This account will store the details of payments, history of check-up, reports payment information. After the patient is diagnosed and the disease is detected, the patient will be notified with the problem and will be suggested a solution according to the level of treatment required. appointment.

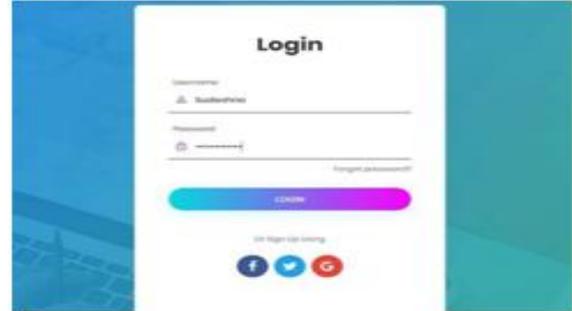


Fig. 10. Login Page

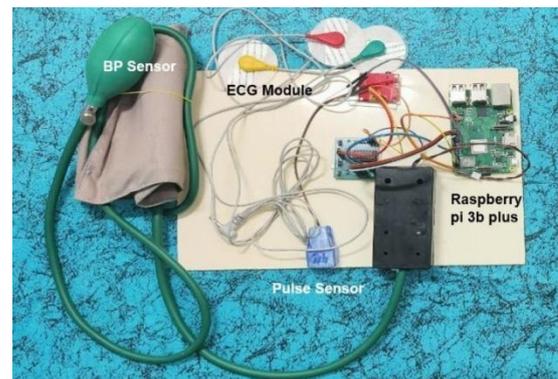


Fig. 8. Prototype of Health Monitoring System



Fig. 9. Homepage of Website

If the problem is minimal, the patient will be suggested with a basic treatment and will be monitored regularly. If the problem is major and requires an immediate attention, the patient will be provided with a list of doctors based on the ratings and appointments of the doctors. Then the patient will be directed to a payment page where he will be asked to pay a nominal fee to continue his check-up. After this both the patient and the doctor will be notified by a mail for the A physician manually vets this report as shown in Fig.11 & Fig.12, thereby validating the information processed on the whole, before the generated report is shared with the user, through Email/WhatsApp in a portable document format(PDF file) with appealing illustrations[11].A chatbot named ”Life Bot” will be continuously monitoring the patient and keep on suggesting some basic daily needs to the patient for proper metabolism.

On the off chance that the person feels to give some response, at that point he can answer back to the system, this answer is sent to the patient for his simplicity in utilizing the recommended medicine.

Diagnosis Report

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		Prakhar779@gmail.com		
VIT Campus, Vellore, Tamil Nadu, IN. 632014				
Patient Name	Device ID	Age(Y)	Gender	
Syeda	9741521795	26	Female	
Diagnosis	Normal Range		Inferred	Remarks
	Low	High		
Blood Pressure (mm HG)	80	120	111	Normal
Temperature (°F)	96.5	99	103	Abnormal
ECG (ms)	120	200	114	Abnormal
Heart Rate (Beats/Minute)	60	100	130	Abnormal

Fig. 11. Report generated with obtained values



Fig. 12. Graph Summary Sheet

V. RESULT

The pulse sensor, blood pressure, temperature and ECG has been examined on an individual and the values are obtained on the Web page. For approval, the outcome is contrasted with the customary method of pulse rate estimation (i.e. the number of heartbeats or pulses per minute). Measurements are made at the wrist of the same individual. On examining it is found that the pulse sensor values are extremely close to the manual calculation. While testing, the information was gathered from temperature measurement sensor and pulse sensor through serial communication port of Raspberry Pi . Fig. 13 shows the real-time readings of pulse sensor and Fig

14. shows the real time data from the temperature sensor. The data can be remotely accessed through the Web Page as well.

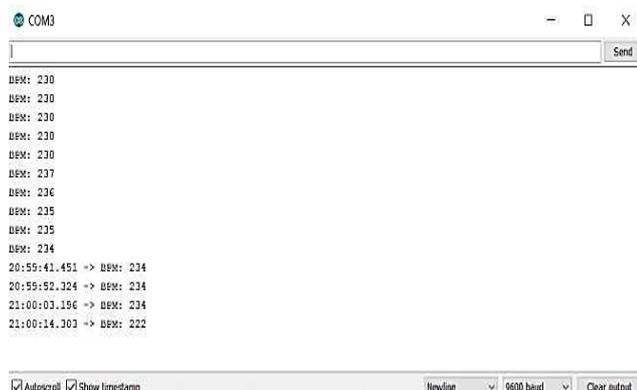


Fig.13.Real-time reading of Pulse Sensor

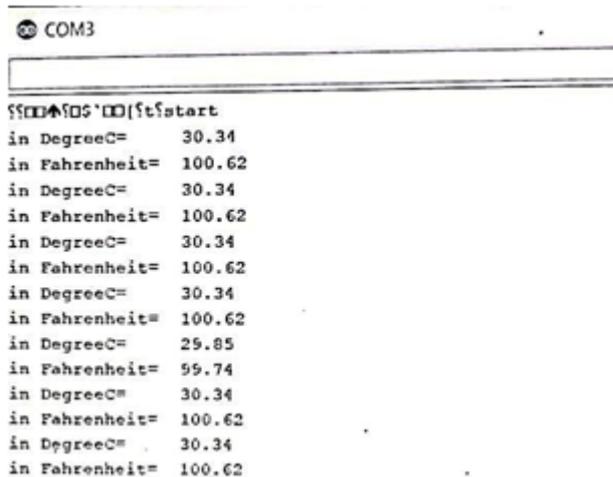


Fig. 14. Real time reading of Temperature Sensor

VI. CONCLUSION

The objective of this paper was to develop, design and implement a real time patient health monitoring system with auto-diagnosis feature. In the results obtained it has been observed that the prototype successfully diagnosis almost 97% of patients for a dataset of 500 patient. However, with more data set the result might slightly reduce. The overall time taken from diagnosis to report generation takes just over 3 min, which is improved by about 9% compared to the other conventional systems. The costing of the prototype has also been reduced by almost 70 % as compared to the available health monitoring units by the smart use of AD8232 ECG module. Thus, a significant improvement in overall efficiency is obtained using the CySician. The work can be further extended to integrate a voice controlled chatbot to assist the patient with general medication and to ease the effort of typing. The ECG sensor is working well, however its performance can be improved by generating cardiac wave-forms for more exhaustive prediction. So, this project can be utilized as a significant tool for the health care associations and the physicians to predict certain severe cases and to exhort the patient likewise. The future scope of our project is to integrate a voice controlled chatbot to assist the patient with general medication and to ease the effort of typing.

A chatbot named “Life Bot” will be continuously monitoring the patient and keep on suggesting some basic daily needs to the patient for proper metabolism[12]. The ECG sensor is working well, however its performance can be improved by generating cardiac wave-forms for more exhaustive prediction. The final health report of the patient after diagnosis will be displayed on the webpage in the similar manner.

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areas are wireless sensor networks and Embedded Systems.



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